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## Wideband Propagation Channel Measurements for Future Railway Mobile Communication Systems

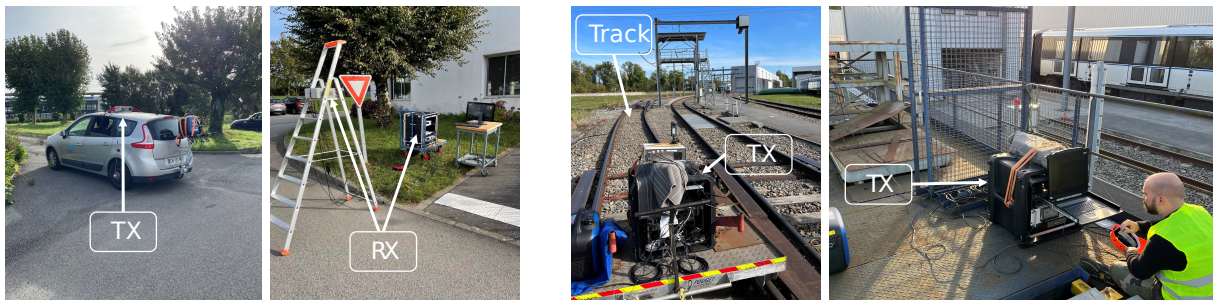
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Channel characterization and modeling are very active topic, thanks to the development of the 5G and beyond. From vehicle-to-vehicle to train-to-train environment the characterization of the channel for mmWave (millimeter Wave) is a hot topic. In [1], a radio link on railway track from Naples to Rome is investigated with different scenarios from platoon to overtakes. Those measurements were performed with the RUSK-DLR channel sounder. Moreover, in [2] static measurements were performed with a regional train. The vehicle-to-vehicle is investigated by the channel sounder from the Brno university in [3] two cars passing towards and away each other. In the case of an ANR project, mmw4Rail, we want to contribute to the modelization of the propagation channel for mmWave in railway environment.

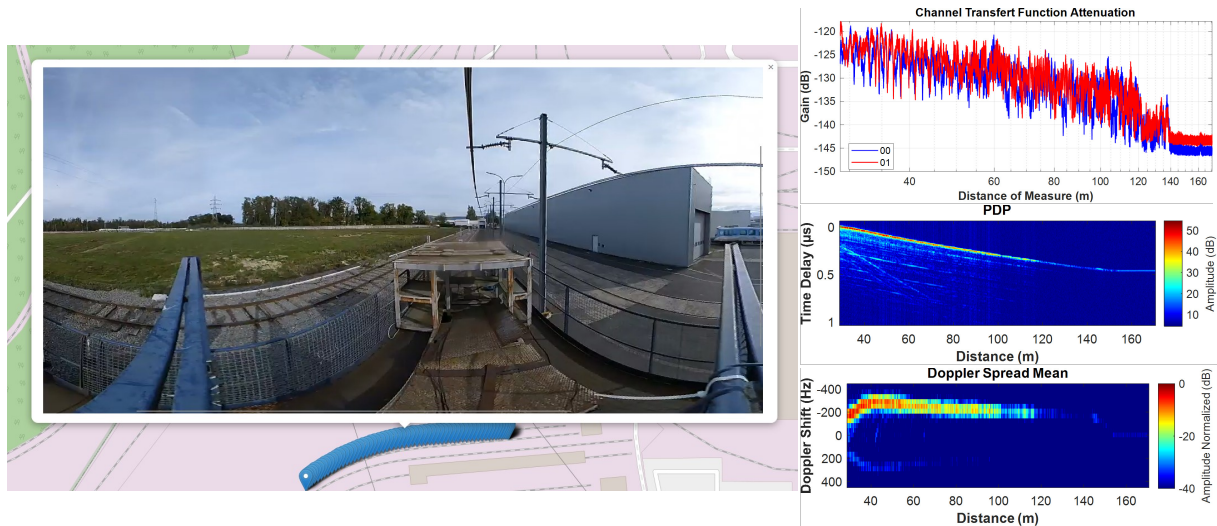
For this purpose, a Single Input Multiple Output (SIMO) Software Radio Defined (SDR) channel sounder has been developed. The architecture is based on Analog Device up and down converter from base band to 60 GHz. This SIMO channel sounder is an upgrade of the SISO sounder presented in [4]. The bandwidth has been increased to reach 180 MHz. To reduce the Power Amplitude to Peak Ration (PAPR), we use a multi-tone signal with Newman phases. The figure 1 shows different installation of the channel sounder. Moreover, the measurement duration is increasing by spatially sampling the channel.



**Figure 1.** Setup in two different environments.

Two measurements campaign have been performed. The first one, in vehicular environment which the installation is presented in the figure 1 (left pictures), to check the correct functionalities of all the upgrade. And a second one which took place at the Railway Trial Center (CEF) in Valenciennes to perform measurements in a real railway environment. The right pictures of the figure 1 shows the installation of the transmitter part of the channel sounder in a trolley and on a train at the CEF.

In the figure 2, we present some preliminary result from measurement realized in railway environment with an horizontally polarized antenna for both Rx and Tx. From the data, we can extract the location of the transmitter and associate a 360 panoramic picture. The attenuation along the move is plotted. The Power Delay Profile (PDP) and the Doppler Spread Function, for one channel is also presented in the figure 2.



**Figure 2.** First results of the measurement campaign realized in CEF.

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